

# FULL SPECTRAL IMAGING; A Revisited Approach to Remote Sensing

John Bolton

NASA Goddard Space Flight Center

EOS Program Office, Code 420

Phone: (301) 286-8547

Fax: (301) 286-1145

e-mail: [john.f.bolton@nasa.gov](mailto:john.f.bolton@nasa.gov)

web: <http://carstad.gsfc.nasa.gov>

# INTRODUCTION

## **The Goal:**

A Full Spectral Imaging (FSI) system will provide remote sensing researchers with high-quality, easy-to-use information.

FSI will provide the kind of information that researchers would have wanted when space borne remote sensing was invented, but that they could not get as the instrument technology was not good enough.

## **Background:**

The discrete band approach to remote sensing was developed because the technology was not available to provide full spectral information.

The technology to provide full spectral information is now available and, if applied properly, could significantly improve the quality of remotely sensed data (information).

The FSI approach to remote sensing is based on the basic principles of reflectance spectrometry (reflectometry).

FSI is the next logical step after multispectral and hyperspectral imaging.

## **Fundamental Concept of FSI:**

FSI deals with *information*, not data

FSI applies primarily to remote sensing instruments that measure reflected solar radiation

FSI is an end-to-end approach to remote sensing

FSI minimizes the problem of “too much data”

FSI answers the question about what to do with all that data

## **MERIS with FSI Example:**

No change to existing instrument technology

Dedicated signal processor would be required

No need to switch between high (300m) and low (1200m) spatial resolutions

Get full spectral coverage ( $\sim 2\text{nm}$  resolution)

No increase in transmitted data rate

## **TWO SELECTED TOPICS**

FSI is a system for remote sensing including everything from the instrument optics to data processing.

The FSI system employs many principles and includes many features. Only two will be discussed:

- 1) Spectral curve principle
- 2) Calibration feature

## **The Spectral Curve Principle:**

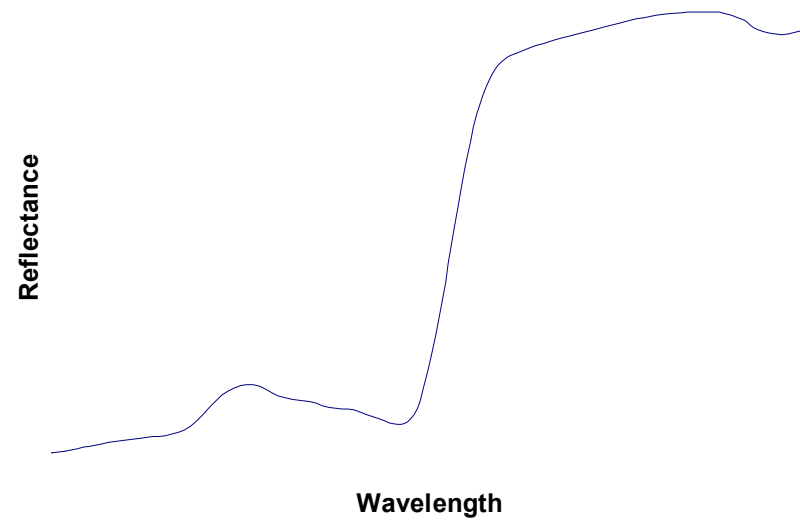
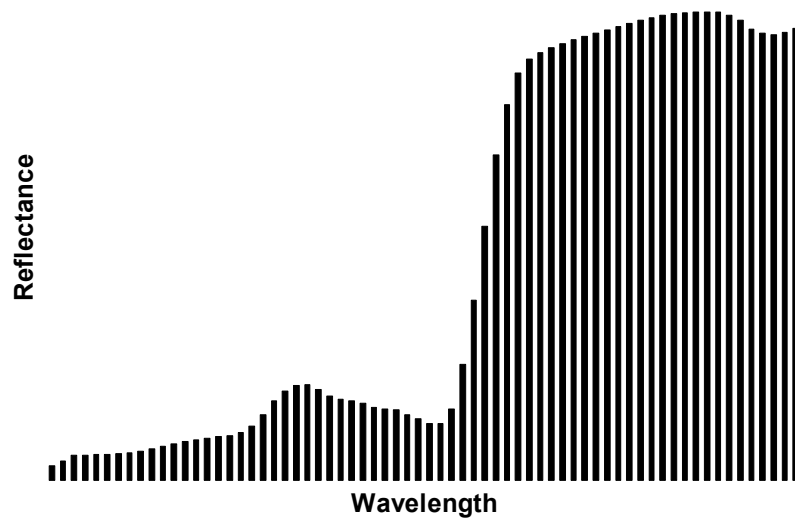
The information in remotely sensed data is in the shape or "features" of the spectral curve.

Measuring more bands provides better definition of the spectral curve.

FSI is the next step beyond multi-band, hyperspectral, superspectral, and ultraspectral.

Spectral curve information is easier to inter-compare than multi-band information.

# Conversion of multiple bands to a spectral curve





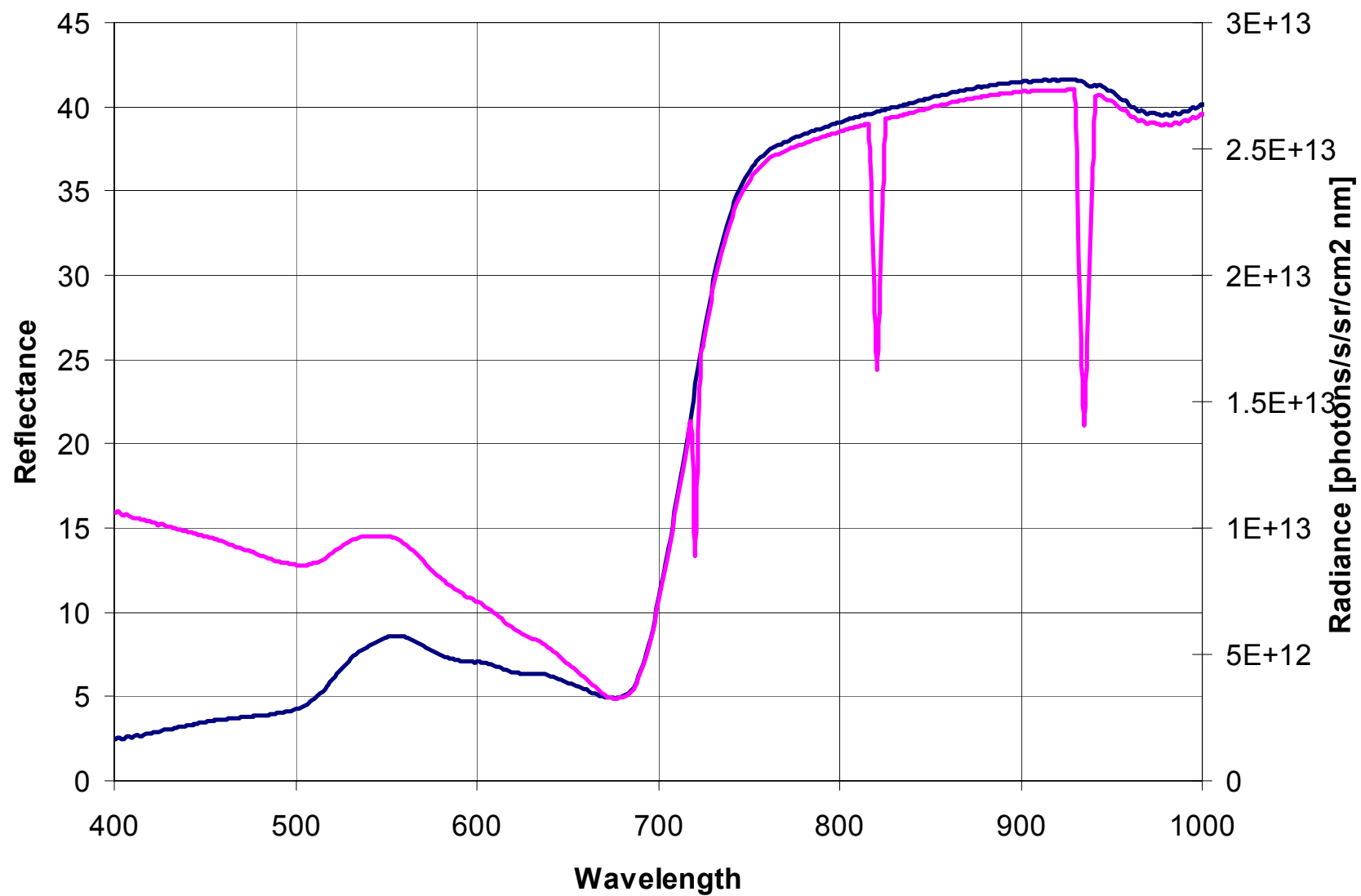
## **The Calibration Feature:**

Researchers want reflectance at the target.

Researchers get radiance at the top of the atmosphere.

Current remote sensing instrumentation requires accurate spectro-radiometric calibration.

The FSI instrument would emphasize accuracy of curve shape rather than absolute radiometric accuracy.



A FSI instrument would have no on-board calibration capability.

Classical reflectance measurements compare the reflectance of a standard to the reflectance of the sample.

A FSI instrument would rely on ground truth and vicarious calibration (empirical retrieval algorithms).

Full spectral information would provide many more “calibration” options.

## **Some Additional Principles & Features:**

- Spectro-Spatial Compression (SSC)
- Multiple focal planes (spectral & spatial)
- Non-linear Analog-to-Digital (A/D) conversion
- All reflective, Earth curvature correcting optics
- No mechanisms or moving parts
- Simplified instrument characterization

## **CONCLUSIONS**

The technology is now available to do optical remote sensing the way it should have been done in the first place.

Adopting FSI will require more of a “mind shift” than a technology shift.

It is time to give remote sensing researchers a “break”. Let them spend their time doing science rather than fixing poor data.